A LONGITUDINAL ANALYSIS OF STRESS, SYMPTOMS OF ANXIETY AND DEPRESSION, IMPULSIVITY, SOCIODEMOGRAPHICS, AND RESILIENCE ON THE DEGREE OF ACQUISITION OF PRESCRIPTION DRUGS AND CANNABIS FROM SOURCES IN COLLEGE STUDENTS

by

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DEDICATION

I would like to dedicate my thesis to multiple people. First and foremost, I want to dedicate the content of my thesis to those that it might help direct them in future research. I also want to thank my fiancé and future wife for her flexibility in dealing with my working at odd hours of the night completing my thesis around other work that I have been doing. I also want to thank my family for pushing me to find my passion and always work hard toward my dream. And, finally, I want to thank the professors at Texas State University, in particular my graduate mentor Dr. Ty Schepis and my research supervisor Dr. Amitai Abramovitch for always pushing for me to do more.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CDC	Centers for Disease Control and Prevention
NSDUH	National Survey on Drug Use and Health
GPA	Grade Point Average
PDM	Prescription Drug Misuse
PHQ-ADS	Patient Health Questionnaire Anxiety and Depression Scale
POM	Prescription Opioid Misuse
PSS-12	12-Item Perceived Stress Scale
UPPS-P	Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency, Impulsive Behavior Scale

I. INTRODUCTION

According to the provisional drug overdose death counts released by the Centers for Disease Control and Prevention (CDC), over 100,000 deaths in the United States were attributed to drug overdoses within a recent 12-month period (Ahmad et al., 2022). The CDC has reported that for every opioid-related teenage death, there are over 120 emergency department visits and 25 hospitalizations due to opioid misuse (Moini et al., 2021).

Despite the reported decline in prescription opioid misuse (POM) prevalence among US residents aged 12 and older—decreasing from 5.4% in 2003 to 4.9% in 2013, according to the U.S. National Survey on Drug Use and Health (NSDUH)—the pattern of decline was inconsistent, with an increase in prescription opioid use disorder rates and more total days of POM for past year misuse (Han et al., 2015). This suggests a trend of decreasing POM prevalence yet an increasing frequency of misuse among those who engage in such behavior. This observation is supported by NSDUH data from 2015 to 2019, which show population-wide POM declines from 4.9% in 2013 to 3.5% in 2019. However, this decline may be misleading in terms of the severity of misuse among the population involved in drug misuse, as suggested by Han et al., 2015. They found that those who are involved in drug misuse are doing so with higher frequency of misuse and using much riskier behaviors.

Prescription drug misuse (PDM), defined as any use of prescription drugs, including benzodiazepines, opioids, or stimulants, without a prescription or in ways not intended by the prescriber (e.g., at higher doses or in combination with other substances such as alcohol), poses a significant challenge among US college students. NSDUH data

from 2009 to 2014 reveal that college students exhibit some of the highest PDM rates, with 8.6% misusing stimulants, 4.3% misusing opioids, and 4.5% misusing sedatives or tranquilizers in the past year (McCabe et al., 2018). Despite downward trends in PDM rates, hospital emergency room visits and deaths due to overdose among college students have increased (Dart et al., 2015; Rudd et al., 2016; Substance Abuse and Mental Health Services Administration, 2020).

In contrast to PDM, cannabis use in the US has been on an upward trajectory since 2002 (Substance Abuse and Mental Health Services Administration, 2020). This trend appears to align with the initiation of medical cannabis legalization in certain US states, such as California (1996), and the subsequent legalization of recreational cannabis use, as seen in Colorado (2012) and Washington (2012) (Cerdá et al., 2020). Since 2016, the majority of US states have legalized medical cannabis, and an increase in use could be anticipated as a result. Additionally, as of March 26, 2023, 21 states have legalized recreational cannabis.

In addition to well-documented side effects of PDM, such as irregular heart rate, stroke, seizures, hypertension, respiratory suppression, overdose, and occasional fatalities, PDM has been linked to decreased academic performance, increased sexual risk-taking behaviors, and heightened depressive symptoms and suicidal thoughts and attempts among college students (Upadhyaya et al., 2010; Arria et al., 2013; Benotch et al., 2011; Juan et al., 2015). Additionally, the self-medicating hypothesis of substance misuse suggests that individuals engage in substance use as a means to alleviate negative emotional states or manage symptoms related to psychiatric disorders (Khantzian, 1997).

The factors influencing PDM severity remain incompletely understood, necessitating further research focusing on these factors within the college student population.

Sources of Misuse

A crucial aspect of the design of preventative measures for prescription drug misuse (PDM) among college students is understanding the sources through which these drugs are acquired. According to the consensus from Schepis & Krishnan-Sarin (2009) and McCabe et al. (2009), identifying the primary sources of PDM is essential for managing this pervasive issue in the United States. This is because distinct sources of PDM have been linked to various risk profiles, which could potentially inform targeted prevention strategies to mitigate the severity of outcomes such as hospitalization, overdose, or death. Research has identified the main sources for PDM as legitimate providers (i.e., prescriptions from doctors), friends or family members providing drugs for free, purchasing from friends or family, and illicit methods (i.e., purchasing from dealers or theft) (McCabe et al., 2018). Moreover, the sources of prescription drugs for PDM vary by age and drug type, with the most common source for college students being friends and family providing drugs for free (McCabe et al., 2018).

Each source is associated with different profiles of risk-taking behaviors; however, some sources are deemed higher-risk due to their correlation with more hazardous behaviors (McCabe et al., 2018). For instance, McCabe et al. (2007) demonstrated that binge drinking and illicit drug use are more prevalent among college students who obtain prescription drugs for PDM from their peers, as opposed to those who acquire the drugs legitimately via prescription. According to McCabe et al. (2018), higher risk is associated with PDM when college students purchase drugs or utilize

multiple sources. Nevertheless, it is important to note that any misuse of prescription drugs carries a greater risk than non-misuse (McCabe et al., 2018).

In line with PDM sources, different sources of cannabis are also linked to distinct risk behaviors. D'Amico et al. (2020) reported that, in California—a state where recreational cannabis distribution is legal—59.1% of young adults obtained cannabis from retailers, 51.5% from friends or family, 39.1% from medical dispensaries, and 5.5% from strangers or drug dealers. Their study found that young adults who received cannabis for free from family and friends were less likely to have cannabis use disorder than those who purchased it from medical or recreational stores. Similar to PDM, each source is associated with risk behaviors concerning cannabis use, with higher risks involving spending more money on cannabis products, using more products, consuming cannabis alone, and facing more consequences for use when procuring cannabis from medical dispensaries or recreational retailers as opposed to receiving it from friends and family (D'Amico et al., 2020).

A limitation in existing research on drug misuse sources is the scarcity of data regarding the degree of drug acquisition from specific sources and how this might affect potential risky behaviors. The degree of acquisition refers to the percentage of usage of sources for drug misuse. Previous research has treated source identification as binary, indicating whether individuals obtained the drug from a particular source or not. However, an individual might obtain drugs from a low-risk source for 29 out of 30 days (96.7%) in a month and from a high-risk source for 1 out of 30 days (3.3%). Traditional research would classify this individual as high-risk, but the degree of drug acquisition might suggest a lower risk profile. This misidentification and incorrect categorization of

individuals into inaccurate risk profiles could complicate prevention efforts and hinder screening efforts for PDM and associated risk behaviors.

Longitudinal studies investigating sources for cannabis misuse have demonstrated that, as circumstances evolve, the sources for drug misuse also shift (Reed et al., 2020). For instance, when an individual transitions from being a patient to no longer requiring medication due to changes in prescription duration or symptom manifestation, they may need to explore alternative sources to acquire prescription drugs for misuse. Additionally, as time progresses, the likelihood of encountering external factors that contribute to or precipitate misuse increases. Therefore, it is imperative to examine the persistent or dynamic factors that may interact with, moderate, or influence the sources of misuse over time. Such factors encompass, but are not limited to, stress, symptoms of anxiety and depression, resiliency, impulsivity, and various sociodemographic variables (e.g., sex at birth, age, gender identity, etc.) among college students.

Potential Interacting Factors of Sources of Misuse

Perceived Stress

Perceived stress should be defined as representing the extent to which an individual feels they experience stress in their life while taking into consideration their coping capabilities (Cohen et al., 1983). Perceived stress among college students varies over time, with students encountering numerous stressors that amplify their perceived stress levels (Baghurst & Kelley, 2013; O'Donovan & Hughes, 2008). Consequently, while some students can internally manage these stress fluctuations, others seek alternative coping strategies, such as PDM.

Substantial evidence indicates a correlation between increased stress levels and heightened cannabis use, suggesting that as stress levels increase, cannabis use increases in individuals that use cannabis (Bonn-Miller et al., 2008, 2011; Conway et al., 2006). Moreover, higher perceived stress has been associated with increased prescription stimulant misuse for cognitive enhancement (Baum et al., 2021; Sattler 2019). However, some studies argue that stress symptoms are not significant predictors of PDM or cannabis use (Holt & McCarthy, 2020; Schepis et al., 2020). Differences in methodology, such as different assessments of stress and different sample populations, could explain these varying results. Notably, there is a considerable research gap concerning how perceived stress levels might impact the sources for PDM and cannabis use.

Symptoms of Anxiety and Depression

In line with the self-medicating hypothesis of substance misuse, Holt & McCarthy (2020) suggest that college students with elevated anxiety symptoms are more likely to misuse prescription stimulants. Furthermore, Cabriales et al. (2013) found that higher anxiety levels and higher depression symptoms increase the risk of PDM. Martins et al. (2012) discovered that mood disorders, major depressive disorder, bipolar disorder, and anxiety disorders are associated with a heightened risk of prescription opioid misuse in a bidirectional fashion. Papp et al. (2021) propose that mental health symptoms might interact with an individual's mood to modify the risk for PDM. Additionally, PDM has been linked to an increased likelihood of depressive and anxiety-related disorders (Schepis & Hakes, 2011; 2013). As such, it is essential to further examine depression and anxiety symptoms to determine their influence on PDM and its sources in college students similar to Schepis et al. (2019).

The use of cannabis for medicinal purposes, particularly as a treatment for anxiety symptoms, has become more prevalent. However, findings regarding the effectiveness of cannabis for anxiety symptom relief are inconsistent, and due to the limited number of studies conducted, definitive conclusions cannot be drawn (Van Ameringen et al., 2020). According to Patrick et al. (2021), cannabis use can fluctuate with depression and anxiety symptoms, contingent on whether individuals employ cannabis to manage these symptoms. Moreover, as depression or anxiety symptoms increase, riskier substance use behaviors, like polysubstance use, becomes more common (Patrick et al., 2021). Additionally, a seven-year longitudinal study demonstrated that depression and anxiety symptoms can fluctuate, and influence individuals' substance use levels over time (Crane et al., 2021).

Despite the consensus that anxiety and depression symptoms may influence substance use, and although Schepis et al. (2019) showed that anxiety and depression may influence sources of PDM in adolescents, there is a significant knowledge gap concerning how depression and anxiety symptoms in college students interact with sources for PDM and cannabis use. Given that anxiety and depressive symptoms regularly fluctuate and are influenced by external factors, it is crucial to investigate how variations in anxiety and depressive symptom levels in college students might interact with the sources of PDM and cannabis use.

Resiliency

The ability to adapt and recover from adverse events, also known as resiliency, has become increasingly acknowledged and accepted as an important component for psychological well-being (Smith et al., 2017). Research has revealed that individuals

exhibiting high resiliency are less prone to exhibit symptoms of anxiety and depression when faced with stressful situations (Zautra et al., 2010). Those individuals with high resiliency typically use more effective coping strategies and demonstrate superior ability in managing perceived stress, lessening the impact of stress on their mental health (Connor & Davidson, 2003).

Studies have indicated that increasing resiliency can positively influence the risk of substance misuse, whether it is opioid misuse, benzodiazepine misuse, stimulant misuse, and cannabis misuse (Brooks et al., 2018). Individuals with greater resiliency demonstrate enhanced self-regulation and decision-making capabilities, which can aid resistance to engaging in substance misuse as a maladaptive coping mechanism (Masten, 2014). Furthermore, Hyman and Sinha (2020) suggested that resiliency can serve as a protective factor against the development of substance use disorders. According to Hyman and Sinha (2020) individuals with heightened resiliency are less inclined to misuse opioids, suggesting they possess superior coping abilities to address stressors that may contribute to the emergence of addiction (Hyman & Sinha, 2020).

Regarding stimulant misuse, Moeller et al. (2018) suggested that resiliency can reduce, or even mitigate, addiction risk by fostering healthy coping strategies and increasing an individual's ability to deal with stress. Similarly, Bonanno et al. (2019) found that individuals higher in resiliency are less prone to misusing cannabis, as they tend to utilize adaptive coping mechanisms rather than resorting to substance use for stress relief.

Additionally, interventions targeting the enhancement of resiliency have demonstrated promising results in reducing substance misuse among at-risk populations

(Greenberg et al., 2012). Programs centering on the development of protective factors, such as social support, emotional regulation, and problem-solving skills, have been identified as effective in diminishing the risk of substance misuse in vulnerable individuals (Werner, 2013). As such, cultivating resiliency might yield substantial benefits in terms of promoting mental health and reducing maladaptive coping strategies, such as substance misuse.

Sociodemographic Characteristics

Distinct sociodemographic factors may affect how individuals obtain drugs for potential misuse. Therefore, it is critical to include sociodemographic factors in analyses as they may be mediators, moderators, or protective factors of sources of acquisition for PDM and/or cannabis use and can help inform education and aid in preventive efforts targeting risky behaviors. For instance, biological sex significantly impacts the source of PDM, with females more likely to obtain drugs from friends or family or steal them compared to males, who are more inclined to purchase drugs or obtain them from a physician (McCabe et al., 2018; Schepis & Krishnan-Sarin, 2009).

Additionally, substantial evidence suggests that age influences sources for PDM and potentially those for cannabis use. Schepis et al. (2020) found that sources for PDM vary significantly by age group, with young adults most commonly acquiring drugs for free from friends or family, whereas adults aged 50 and older are more likely to obtain drugs from a physician. Given the considerable variation in college students' ages, it is imperative to account for age when examining the impact of other factors on sources for PDM and cannabis use.

Regarding other sociodemographic factors, research shows that lower GPA is

associated with higher polysubstance use over time, which could, in turn, affect sources of PDM or cannabis use (Crane et al., 2021). Furthermore, Crane et al. (2021) suggests that biological sex may serve as a moderator for other factors influencing PDM or cannabis misuse (e.g., depression symptoms in males), potentially impacting sources for PDM or cannabis use.

There are two prevailing theories concerning the role of parental education and socioeconomic status in substance use. The first, more widely accepted, theory posits that substance use is strongly influenced by socioeconomic and educational factors at both extremes. For example, some evidence indicates that individuals with lower socioeconomic status and lower parental education exhibit greater substance use involvement (Fothergill & Ensminger, 2006; Goodman & Huang, 2002; Lemstra et al., 2008; Pena et al., 2008). This is attributed to increased stress in low-income and low-education households, leading to decreased parental monitoring or warmth and a heightened risk of substance abuse. Conversely, other studies suggest that higher socioeconomic status and higher parental education correlate with increased substance use (Luthar & Becker 2002; Luther & Latendresse 2005; Hanson & Chen 2007; Tuinstra et al., 1998). This phenomenon is linked to greater availability and financial access to substances, diminished parental involvement, and boredom in high-income and high-education households. The alternative, less accepted, theory posits that peer and school influences override the pressures imposed by socioeconomic status and parental education (West, 1997). This perspective is grounded in the clustering of deviant peers, affiliative friendships, and problem-behavior theory. Given the lack of consensus and substantial evidence suggesting some impact of socioeconomic status and parental

education on substance use, it is crucial to assess whether these factors may serve as significant predictors, moderators, or protectors for specific sources of PDM or cannabis use.

Like studies on socioeconomic status and parental education, investigations into the effects of race and ethnicity on sources of prescription drugs yield mixed results. Some research indicates that white individuals are more likely to acquire drugs from friends and relatives and purchase drugs for PDM than Black/African Americans and Hispanics, who are more likely to obtain drugs from physicians (Schepis & Krishnan-Sarin, 2009). However, according to Hasin et al. (2019), cannabis use prevalence associated with race and ethnicity has remained stable over the past 20 years. Given the importance of race and ethnicity in cannabis use, further examination and consideration of their potential impact on sources for obtaining cannabis is essential.

Abundant evidence demonstrates that religiosity is negatively associated with substance use (Blay et al., 2008; Chi et al., 2009; Francis and Mullen, 1993; Ghandour et al., 2009; Harden, 2010), suggesting that individuals with high religiosity have a significantly lower risk of substance use. Consequently, it is important to examine the influence of religiosity on sources of PDM and cannabis use.

Given the evidence that these sociodemographic factors may influence PDM, cannabis use, and their sources, it is vital to evaluate the interactive and protective qualities associated with each factor. This will enable a better understanding of the risks associated with each source of misuse and help identify protective pathways against risky behaviors that can lead to hospitalizations, overdoses, and even death.

The Present Study

The aim of this study was to fill a gap in knowledge about how degree of acquisition of drugs for PDM and cannabis use each interact with factors that may change over time that impact college students in the US. The proposed study examined the relationship between resiliency scores, symptoms of anxiety and depression, and perceived stress scores with PDM and cannabis use. It also examined the relationship between resiliency scores, symptoms of anxiety and depression, and perceived stress scores and sources of acquisition, including the degree of acquisition of drugs for PDM and cannabis. The proposed study examined the relationship for sociodemographic characteristics in the previously mentioned relationships. The study also examined how those relationships changed over a three-month period.

Participants were be issued three surveys: an initial survey and two follow-up surveys. I predicted that there would be a positive correlation between anxiety and depression scores and higher degree of acquisition from riskier sources (e.g., buying drugs for PDM or buying cannabis from a drug dealer), in which, as depression and anxiety scores increased, (1a) PDM and cannabis use would increase as well as (1b) acquisition from riskier sources would increase. I predicted that there would be a negative correlation between resiliency scores and higher degree of acquisition from riskier sources, in which, as resiliency scores increased, (2a) PDM and cannabis use would decrease as well as (2b) acquisition from riskier sources would decrease. Further, (3) lower resiliency scores, mediated through higher anxiety and depressive scores, would lead to more frequent PDM. Also, there would be a positive correlation between perceived stress levels and higher degree of acquisition from riskier sources, in which, as

perceived stress scores increased, (4a) PDM and cannabis use would increase as well as (4b) acquisition from riskier sources would increase. Additionally, (5) I predicted specific sociodemographic factors of sex, parental education, socioeconomic status, race/ethnicity, age, job status, and GPA would correlate with degree acquisition from sources, because there is not enough information on direction of correlation of sociodemographic factors and PDM and cannabis use, I did not make an informed prediction of direction.

II. METHOD

Participants

As this was a longitudinal correlational study, there was an initial survey sent to a larger sample to identify a specific subset of individuals that qualified for the follow-up surveys.

For the initial survey (T0), 932 participants (741 female: 186 male), ages 18 or older, were recruited. The participants were recruited through the SONA system recruiting pool and individuals who were in upper-division classes were also be approached to participate to broaden the range of potential participants. The sociodemographic characteristics of baseline participants are captured in Table 1 (please see Results).

For the follow-up surveys, 176 participants (116 female: 60 male), ages 18 or older, were recruited through the initial survey and invited to complete the follow-up surveys. Participants were sent the follow-up surveys if they completed T0 survey, provided an email for contact, and responded with any past year PDM and/or past 30 day cannabis use. For sociodemographic characteristics for those who completed the initial follow-up survey (T1) and the second follow-up survey (T2), please see Table 1 in the Results. Procedures were approved by the Institutional Review Board at Texas State University (Project 8157).

Materials and Design

The design of this study was a longitudinal correlational study. The variables of interest in this study were substance use, degree of acquisition from sources of medication for PDM and cannabis, sociodemographic factors, symptoms of anxiety and

depression, impulsivity, stress, and resiliency.

Substance Use

Statements and questions from the National Survey on Drug Use and Health were used and altered to meet the criteria of this study (SAMSA, 2020). These statements and questions pertain to each substance questioned in the study: prescription pain relievers (opioids), prescription stimulants, prescription tranquilizers, alcohol, and cannabis.

Prior to each class of drug, participants were given a description of misuse of each class of drug along with examples of common names of the drugs (if applicable) and pictures of the drugs (if applicable). Then, participants were asked to identify whether they have misused each type of drug in their lifetime. If participants answered yes, they were asked a series of follow-up questions pertaining to the type of drug that they had misused, the age of first misuse, the recency of misuse, the frequency of misuse, and, finally, to identify the source(s) from which they obtained the drugs for misuse.

Degree of Acquisition

For participants that respond with PDM or cannabis use, participants were asked to estimate the percentage of use of each different source of PDM or cannabis.

Sociodemographic Characteristics

Participants were asked to fill out information about general sociodemographic characteristics (e.g., sex at birth, age, gender identification, etc.). For more detailed sociodemographic information see Table 1 in the Results.

Symptoms of Anxiety and Depression

Symptoms of anxiety and depression were assessed using the Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS; Kroenke et al., 2016). This

scale measures depression and anxiety symptoms and has been used previously in PDM research involving a similar population. Additionally, in the current study, PHQ-ADS showed excellent internal consistency ($\alpha = .938$). Participants are asked to respond to 16 statements such as, "Over the last two weeks, have you been bothered by little interest or pleasure in doing things?" based on a 4-point Likert scale, with responses of "Not at all, several days, more than half the days, nearly every day." Scores to all statements are then added up and cut-off points of 10, 20, and 30 indicate mild, moderate, and severe levels of depression and anxiety relatively. Furthermore, the scores of PHQ-ADS have been shown to be sensitive to short-term changes in depression and anxiety (Kroenke et al., 2016).

Impulsivity

Impulsivity was assessed using the short version of the Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency, Impulsive Behavior Scale (UPPS-P; Lynam, 2013). This scale assesses 5 subscales: negative urgency, lack of perseverance, lack of premeditation, sensation seeking, and positive urgency with four statements for each subscale for a total of 20 statements using a 4-point Likert scale of strongly agree to strongly disagree. An example statement of negative urgency is "When I feel bad, I will often do things I later regret in order to make myself feel better now" (reverse coded). An example statement of lack of perseverance is "I generally like to see things through to the end." An example statement of lack of premeditation is "My thinking is usually careful and purposeful." An example statement of sensation seeking is "I quite enjoy taking risks" (reverse coded). An example statement of positive urgency is "When I am in great mood, I tend to get into situations that could cause me problems" (reverse coded). In a

sample of undergraduate students, shows similar consistency to the full version of the UPPS-P (α = .74 to .88) across all subscales and, therefore, was shown to by a valid alternative to the full version of the UPPS-P (Cyders et al., 2014). In the current study, the short UPPS-P had good internal consistency (α = .81).

Perceived Stress

Perceived stress was assessed using the 12-item Perceived Stress Scale (PSS-12; Eubank et al., 2021). This scale measures perceived stress and accounts for stress associated with the COVID-19 pandemic and has been used previously in PDM research in a similar population. Participants are asked to respond to 13 questions using a 5-point Likert scale of never to very often. An example statement is "How often have you felt that you were unable to control the important things in your life?" The psychometric properties of the PSS-12 were analyzed using undergraduate students, showing good internal consistency (α = .90) (Eubank et al., 2021). In the current study, the PSS-12 showed good internal consistency (α = .83).

Resiliency

Resiliency was assessed using the Brief Resilience Scale (BRS; Smith et al., 2008). This scale measures resiliency and has been validated on undergraduate populations. Participants are asked to respond to 6 statements using a 5-point Likert scale of strongly disagree to strongly agree. An example statement is "I tend to bounce back quickly after hard times." The psychometric properties of the Brief Resilience Scale were assessed in a population of undergraduate students, showing good internal consistency of (α = .80 - .91) (Smith et al., 2008). In the current study, the BRS showed good internal consistency (α = .82).

Procedure

Participants had access to a link to the initial survey via the SONA system or through their upper-division class website. Upon opening the survey, participants read the informed consent form, were informed of any compensation, and completed the survey if they consented to participate.

The initial survey took participants no more than 30 minutes and assessed substance misuse (recency, frequency, and age of initiation), sources of medication for PDM and cannabis and degree of acquisition from sources, sociodemographic characteristics, symptoms of anxiety and depression using the PHQ-ADS, impulsivity using the short version of the UPPS-P, perceived stress using the PSS-12, and resiliency using the BRS. Participants who completed the baseline survey either received course credit (if in PSY 1300 and using the SONA system) or extra credit, as determined by their instructor (for upper division classes).

The follow-up surveys took participants no more than 15 minutes and assessed substance misuse (recency and frequency), sources of medication for PDM and cannabis use and degree of acquisition from sources, symptoms of anxiety and depression using the PHQ-ADS, perceived stress using the PSS-12, and resiliency using the BRS. Participants were only sent the first follow-up survey if they provided an ID and email in the initial study and responded with any past year PDM and/or any past 30 day cannabis use. The participants were only sent the second follow-up survey if they completed the first follow-up survey and provided an ID. Participants were compensated with a $5 Amazon gift card for completion of each follow-up survey (for a possible total of $10).

Data Analysis

Preliminary data analyses were conducted to ensure that all assumptions for all statistical tests are met. Prior to any analyses, descriptive statistics of scores on each scale were run and through analysis of the histograms and p-p plots, along with analysis of skewness and kurtosis, the assumptions of multivariate normality were assessed. Through analysis of the histogram plots and p-p plot, and through evidence that kurtosis and skewness both do not surpass -1 or 1, it was determined that the assumptions of multivariate normality were not violated.

Because of severe attrition in responses to the follow-up surveys, independent t-tests were run to see if there were significant differences between responders and non-responders of T1 in T0 response values of depression and anxiety scores, perceived stress scores, and resiliency scores. Additionally, independent t-tests were run to see if there were significant differences between responders and non-responders of T2 in T1 response values of depression and anxiety scores, perceived stress scores and resiliency scores.

Because there was not a significant difference between non-responders and responders from T0 to T2, in both depression and anxiety scores and resiliency scores, an initial zero-order correlation analysis was run to investigate correlations between depression and anxiety scores and resiliency scores and outcome variables of interest (e.g., opioid misuse, stimulant misuse, etc.). Additionally, because there was not a significant difference between non-responders and responders in depression and anxiety scores and resiliency scores, and perceived stress scores at a minimum of one of the time point comparisons (e.g., T0 vs. T1, T1 vs. T2, or T0 vs. T2), a repeated measures ANOVA was run to assess if there was a significant change in resiliency scores,

depression and anxiety scores, or perceived stress scores over time. Finally, planned simple mediation analyses were run to investigate multiple comparisons.

The planned simple mediation analyses were run using PROCESS v4.2 in SPSS using the following outcome variables in each separate analysis: (1) change in cannabis use from T0 to T1, (2) change in stimulant use from T0 to T1, (3) change in benzodiazepine use from T0 to T1, (4) change in stimulant use from T1 to T2, (5) change in cannabis use from T1 to T2, and (6) change in cannabis use from T0 to T2. All other previously planned mediation analyses were removed due to lack of responses in the sample.

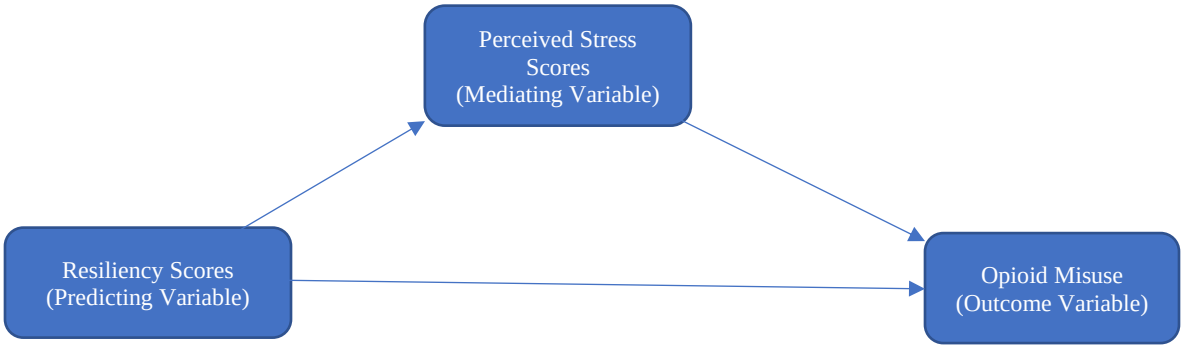
Change in use was calculated using response to last 30 days of use, a difference from previous 30-day response in T0 for T1 or T1 for T2 would signify change and direction in change (e.g., participants that responded with cannabis use in the past 30 days in T0 and then responded with no cannabis use in the past 30 days for T1 would be given a value of -1, participants that responded with no cannabis use in the past 30 days in T0 and then responded with no cannabis use in the past 30 days for T1 would be given a value of 0, and participants that responded with no cannabis use in T0 and responded with cannabis use in T1 would be given a value of 1). Change in resiliency scores, depression and anxiety scores, and perceived stress scores were calculated by subtracting the score from the preceding survey from the survey of interest (e.g. to calculate the change in resiliency at T2, subtract the resiliency score at T1 from the resiliency score at T2).

All planned mediation analyses used resiliency or change in resiliency, as the predictor variable in each separate analysis. The planned mediation analyses used

depression and anxiety scores, perceived stress scores, change in depression and anxiety scores, or change in perceived stress scores as mediating variables. An additional bivariate correlational analysis was run using degree of acquisition of drugs along with perceived stress scores, depression and anxiety scores, and resiliency scores for each time point (T0, T1, and T2). Because multiple mediation analyses were run and the Bonferroni procedure was implemented by setting the target *p*-value equal to α/C, where C is the number of tests performed. For this study, six mediation analyses were run, thereby the target *p*-value was .05/6, or .0083. Bootstrapped values (5000 iterations) of standard error and 95% confidence intervals were reported. For visualization of mediation analyses, see Figure 1 for conceptual model.

Figure 1

Conceptual Model of Simple Mediation



Note. The outcome variable, predicting variable and mediating variable were replaced appropriately in each analysis.

III. RESULTS

Preliminary Analyses

Descriptive statistics were run on sociodemographic variables, for detailed sociodemographic information see Table 1.

Table 1

Sociodemographic Information of T0, T1, and T2

	T0	T1	T2
Factor	% (n)	% (n)	% (n)
Age (*M* = 19.46, *SD* = 2.79)			
18 to 24	96.8% (902)	92.1% (70)	86.2% (25)
25 to 33	1.9% (18)	6.5% (5)	10.2% (3)
34+	.9% (8)	1.3% (1)	3.4% (1)
Sex at Birth			
Male	20.0% (186)	9.2% (7)	3.4% (1)
Female	79.5% (741)	90.8% (69)	96.6% (28)
Prefer not to Say	.4% (4)	0% (0)	0% (0)
Gender Identity			
Male	19.3% (180)	7.9% (6)	3.4% (1)
Female	77.3% (720)	84.2% (64)	82.8% (24)
Transgender Female	.3% (3)	0% (0)	0% (0)
Transgender Male	.2% (2)	1.3% (1)	3.4% (1)
Genderqueer	.5% (5)	1.3% (1)	0% (0)
Gender-nonconforming	.8% (7)	0% (0)	0% (0)
Other	.9% (8)	1.3% (1)	3.4% (1)
Prefer not to Say	.4% (4)	3.9% (3)	6.9% (2)
Sexual Orientation			
Asexual	2.7% (25)	1.3% (1)	3.4% (1)
Bisexual	14.1% (131)	25.0% (19)	31.0% (9)
Gay	1.3% (12)	2.6% (2)	3.4% (1)
Heterosexual/Straight	71.2% (664)	55.3% (42)	44.8% (13)
Lesbian	2.8% (26)	5.3% (4)	2.8% (2)
Queer	1.3% (12)	2.6% (2)	6.9% (12)
Questioning	2.0% (19)	2.6% (2)	3.4% (1)
Pansexual	1.3% (12)	1.3% (1)	0% (0)
Other	.5% (5)	0% (0)	0% (0)
Prefer not to Say	2.1% (20)	3.9% (3)	6.9% (2)
Mother Education			
Less than High School Diploma	7.6% (71)	9.2% (7)	6.9% (2)
High School Diploma or GED	21.5% (200)	13.2% (10)	17.2% (5)
Some College, no degree	19.7% (184)	21.1% (16)	27.6% (8)
Associate's Degree	8.5% (79)	9.2% (7)	3.4% (1)
Bachelor's Degree	27.4% (255)	30.3% (23)	24.1% (7)
Master's Degree	12.0% (112)	13.2% (10)	13.8% (4)
Professional Degree	.5% (5)	1.3% (1)	0% (0)
Doctorate	1.5% (14)	2.6% (2)	6.9% (2)
Do Not Know	1.1% (10)	0% (0)	0% (0)
Father Education			
Less than High School Diploma	9.5% (89)	6.6% (5)	10.3% (3)
High School Diploma or GED	23.7% (221)	18.4% (14)	17.2% (5)
Some College, no degree	16.5% (154)	17.1% (13)	20.7% (6)
Associate's Degree	6.3% (59)	7.9% (6)	10.3% (3)
Bachelor's Degree	24.4% (227)	31.6% (24)	31.0% (9)
Master's Degree	10.5% (98)	10.5% (8)	10.3% (3)
Professional Degree	1.0% (9)	1.3% (1)	0% (0)
Doctorate	2.8% (26)	5.3% (4)	0% (0)
Do Not Know	4.9% (46)	1.3% (1)	0% (0)
Ethnicity			
Hispanic/Latinx/Spanish Origin	45.4% (423)	42.1% (32)	37.9% (11)
Not Hispanic/Latinx/Spanish Origin	54.4% (507)	57.9% (44)	62.1% (18)
Race Identity			
American Indian/Alaskan Native	2.8% (26)	1.3% (1)	0% (0)
Asian	4.9% (46)	3.9% (3)	3.4% (1)
Black/African American	13.2% (123)	11.8% (9)	10.3% (3)
Hawaiian/Other Pacific Islander	1.6% (15)	1.3% (1)	0% (0)
White/Caucasian	75.6% (705)	76.3% (58)	75.9% (22)

Other	6.5% (61)	7.9% (6)	13.8% (4)
Employment Status			
Full-time (40 or more hours per week)	2.5% (23)	6.6% (5)	6.9% (2)
Part-time (up to 39 hours per week)	37.4% (349)	36.8% (28)	34.5% (10)
Self-Employed	3.0% (28)	2.6% (2)	3.4% (1)
Unemployed	57.0% (531)	53.9% (41)	55.2% (16)
Household Income			
Less than $20,000	13.4% (125)	18.4% (14)	24.1% (7)
$20,000 - $34,999	13.8% (129)	11.8% (9)	6.9% (2)
$35,000 - $49,999	10.9% (102)	10.5% (8)	3.4% (1)
$50,000 - $74,999	17.4% (162)	18.4% (14)	13.8% (4)
$75,000 - $99,999	14.3% (133)	14.5% (11)	17.2% (5)
Over $100,000	29.2% (272)	25.0% (19)	34.5% (10)
Classification in School			
Freshman	53.1% (495)	34.2% (26)	31.0% (9)
Sophomore	20.1% (187)	22.4% (17)	27.6% (8)
Junior	15.7% (146)	22.4% (17)	10.3% (3)
Senior	10.3% (96)	19.7% (15)	27.6% (8)
Other	.4% (4)	1.3% (1)	3.4% (1)
Overall GPA			
Under 2.0	2.8% (26)	0% (0)	0% (0)
2.0 to 2.49	7.5% (70)	5.3% (4)	3.4% (1)
2.5 to 2.99	17.1% (159)	15.8% (12)	6.9% (2)
3.0 to 3.49	36.9% (344)	32.9% (25)	31.0% (9)
3.5 to 3.99	29.1% (271)	39.5% (30)	48.3% (14)
4.0	5.9% (55)	5.3% (4)	10.3% (3)

Note. n (T0) = 932; n (T1) = 76; n (T2) = 29. T0, Responses from initial survey; T1, Responses from the first follow-up survey; T2, Responses from the second follow-up survey. Mean and Standard Deviation Data for Age represent T0.

Descriptive statistics were run at T0, T1, and T2 on past 30-day PDM in opioids, stimulants, benzodiazepines, and cannabis use, see Table 2 for more detailed information.

Table 2

PDM and Cannabis Use at T0, T1, and T2

Drug	T0 % (n)	T1 % (n)	T2 % (n)
Opioid	.6% (6)	0.0% (0)	0.0% (0)
Stimulant	6.5% (61)	2.6% (2)	3.4% (1)
Benzodiazepines	.4% (4)	0.0% (0)	0.0% (0)
Cannabis	34.2% (319)	51.3% (39)	37.9% (11)

Note. n (T0) = 932; n (T1) = 76; n (T2) = 29. T0, Responses from initial survey; T1, Responses from the first follow-up survey; T2, Responses from the second follow-up survey; PDM, Prescription drug misuse.

Because of severe attrition in responses to the follow-up surveys, analyses were run to see if there were significant differences between responders and non-responders of T1 in T0 response values of depression and anxiety scores, perceived stress scores, and

resiliency scores. Additionally, analyses were run to see if there were significant differences between responders and non-responders of T2 in T1 response values of depression and anxiety scores, perceived stress scores and resiliency scores. Equal variances were assumed with Lavene's test for equality of variances $p > .05$ in all tests. Independent t-tests revealed there were no significant differences on initial response values between responders and non-responders of T1 in depression and anxiety scores, perceived stress scores, and resiliency scores. However, independent t-tests revealed responders of T2 perceived stress scores ($M = 39.97$, $SD = 7.56$) were significantly higher than the perceived stress scores of non-responders of T2 ($M = 35.53$, $SD = 8.55$) in T1 perceived stress scores, $t\ (67) = 2.23$, $p = .029$, $d = .545$ (For more detailed information, see Table 3).

Table 3

Differences in Non-Response and Response on Depression, Anxiety, Stress, and Resiliency

Groups and Scales	*n*	t	*p*	*d*	*Mean Difference*
T1 Responders vs. T1 Non-Responders					
T0 BRS	175	-.900	.369	-.137	-.104
T0 PSS	175	1.079	.282	.164	1.363
T0 PHQ	174	1.11	.268	.170	1.767
T1 Responders vs. T2 Responders					
T0 BRS	76	-.268	.789	-.064	-.049
T0 PSS	76	1.422	.159	.336	3.135
T0 PHQ	76	1.009	.316	.238	2.498
T2 Responders vs. T2 Non-Responders					
T1 BRS	71	.078	.938	.019	.0144
T1 PSS	69	2.234	.029	.545	4.441
T1 PHQ	72	.945	.348	-.246	2.176

Note. T0, Initial Survey; T1, First Follow-up; T2, Second Follow-up; BRS, Brief Resilience Scale score total; PSS, Perceived Stress Scale-12 score total; PHQ, Patient Health Questionnaire Anxiety and Depression score total.

Sources Used and Change in Sources Used Over Time

Descriptive statistics for sources used for acquisition of drugs for PDM and cannabis use in the past 30 days at T0, T1, and T2 can be seen in Tables 4 and 5. However, some respondents did not respond with any source information about how they obtained their drugs for PDM or how they obtained their cannabis and thereby follow-up inferential testing were eliminated.

Table 4

Sources of Prescription Drug Misuse Reported in T0 through T2

Source	T0 Opioid % (n)	T0 Stimulant % (n)	T0 Benzodiazepines % (n)	T1 Stimulant % (n)
I got a prescription from just one doctor	50% (3)	27.9% (17)	0% (0)	50.0% (1)
I got a prescription from more than one doctor	0% (0)	0% (0)	0% (0)	0.0% (0)
I stole the prescription from a doctor's office, clinic, hospital or pharmacy	0% (0)	3.3% (2)	0% (0)	0.0% (0)
I got the prescription drugs from a friend for free	33.3% (2)	32.8% (20)	25% (1)	50.0% (1)
I got the prescription drugs from a relative for free	50% (3)	9.8% (6)	0% (0)	0.0% (0)
I bought the prescription drugs from a friend	16.7% (1)	19.7% (12)	25% (1)	0.0% (0)
I bought the prescription drugs from a relative	0% (0)	1.6% (1)	0% (0)	0.0% (0)
I took the prescription drugs from a friend without asking	0% (0)	0% (0)	0% (0)	0.0% (0)
I took the prescription drugs from a relative without asking	0% (0)	1.6% (1)	0% (0)	0.0% (0)
I bought the prescription drugs from a drug dealer or other stranger	0% (0)	6.6% (4)	0% (0)	0.0% (0)
I got the prescription drugs in some other way	0% (0)	6.6% (4)	0% (0)	0.0% (0)

Note. n(T0 opioid) = 6. n(T0 stimulant) = 61. n(T0 benzodiazepine) = 4. n(T1 stimulant) = 2. T0 = Initial Survey Responses. T1 = First Follow-up Responses. Percentage numbers represent the % of those that reported misuse of prescription drug class in the past 30 days prior to T0 or T1. Additionally, some respondents did not respond with any source

that they obtained their drugs (e.g. Benzodiazepines only have 2 reported sources, accounting for, at a maximum, two of the four participants that responded with benzodiazepine misuse).

Table 5

Sources of Cannabis for Use Reported in T0 through T2

Source	T0 % (n)	T1 % (n)	T2 % (n)
I got the Cannabis from a prescription from a doctor	.6% (2)	0.0% (0)	0.0% (0)
I bought the Cannabis from a Cannabis dispensary	8.5% (27)	7.7% (3)	0.0% (0)
I stole the Cannabis from a dispensary	.6% (2)	0.0% (0)	0.0% (0)
I got the Cannabis from a friend for free	40.8% (130)	48.7% (19)	54.5% (6)
I got the Cannabis from a relative for free	6.6% (21)	2.6% (1)	0.0% (0)
I bought the Cannabis from a friend	15.7% (50)	15.4% (6)	9.1% (1)
I bought the Cannabis from a relative	.6% (2)	.6% (2)	0.0% (0)
I took the Cannabis from a friend without asking	0.0% (0)	0.0% (0)	9.1% (1)
I took the Cannabis from a relative without asking	0.0% (0)	2.6% (1)	0.0% (0)
I bought the Cannabis from a drug dealer or other stranger	19.1% (61)	17.9% (7)	18.2% (2)
I got the Cannabis in some other way	6.3% (20)	5.1% (2)	9.1% (1)

Note. n (T0) = 319. n (T1) = 39. n (T2) = 11. T0 = Initial Survey Responses. T1 = First Follow-up Survey Responses. T2 = Second Follow-up Survey Responses. Percentage numbers represent the % of those that reported cannabis use in the past 30 days prior to T0, T1 and T2. Additionally, some respondents did not respond with any source that they obtained their cannabis.

Primary Analysis

Repeated measures ANOVA revealed significant changes in resiliency scores, F (1, 27) = 7.720, p = .010, η_p^2 = .222. There was not a significant difference between participants' reported resiliency scores at T0 (M = 3.13, SD = .69) compared to T1 nor

the resiliency at T1 (*M* = 3.27, *SD* = .71) compared to T2 (*M* = 3.38, *SD* = .75); however, responders of T2 resiliency scores at T0 were significantly lower than their resiliency scores at T2 (see Table 3 for detailed statistical information).

Repeated measures ANOVA revealed significant changes in depression and anxiety scores, F (1, 27) = 9.187, p = .005, η_p^2 = .254. There was not a significant difference between participants' T0 anxiety and depression scores (*M* = 17.29, *SD* = 10.27) compared to T1 scores (*M* = 16.50, *SD* = 9.70); however, participants' anxiety and depression scores at T0 were significantly higher than participants' anxiety and depression scores at T2 (*M* = 13.68, *SD* = 9.72). Additionally, participants' anxiety and depression scores at the T1 were significantly higher than participants' anxiety and depression scores at T2 (see Table 3 for detailed statistical information).

Repeated measures ANOVA revealed significant changes in perceived stress scores, F (1, 27) = 9.781, p = .004, η_p^2 = .266. There was not a significant difference between participants' T0 perceived stress scores (*M* = 40.89, *SD* = 11.12) compared to T1 perceived stress scores (*M* = 39.57, *SD* = 7.39); however, participants' T0 perceived stress scores were significantly higher than their T2 perceived stress scores (*M* = 36.04, *SD* = 8.21). Additionally, participants' T1 perceived stress scores were significantly higher compared to their T2 perceived stress scores (see Table 6 for detailed statistical information).

Table 6

Repeated Measures ANOVA of PHQ-ADS, BRS, and PSS-12

Scales	n	*p*	η_p^2	*Mean Difference*	95% *CI* *LL, UL*
PHQ-ADS, F (1, 27) = 9.187	28	.005	.254		
T0 vs. T1	28	1.00		.786	-2.656, 4.228
T0 vs. T2	28	.016		3.607	.570, 6.645
T1 vs. T2	28	.021		2.821	.362, 5.281

BRS, F (1, 27) = 7.720		.010	.222		
T0 vs. T1	28	.420		-.149	-.399, .101
T0 vs. T2	28	.029		-.256	-.491, -.021
T1 vs. T2	28	.793		-.107	-.347, .133
PSS-12 F (1, 27) = 9.781		.004	.266		
T0 vs. T1	28	1.00		1.321	-2.667, 5.310
T0 vs. T2	28	.013		4.857	.893, 8.821
T1 vs. T2	28	.006		3.536	.882, 6.189

Note. Initial Survey; T1, First Follow-up; T2, Second Follow-up; BRS, Brief Resilience Scale score total; PSS, Perceived Stress Scale-12 score total; PHQ, Patient Health Questionnaire Anxiety and Depression score total; CI, Confidence Intervals; LL, Lower Limit; UL, Upper Limit.

Zero-order correlational analyses between change in resiliency scores and depression and anxiety scores revealed that there was no significant correlation the two scores; however, there were significant correlations between changes within each scale of scores, see Table 7 for more detailed information. Perceived stress scores were removed due to significant differences between responders and non-responders.

Table 7

Correlational Analysis of Change in Depression and Anxiety Scores and Resiliency

	Depression and Anxiety Change from T0 to T2 r (p)	Depression and Anxiety Change from T0 to T1 r (p)	Depression and Anxiety Change from T1 to T2 r (p)	Resiliency Change from T1 to T2 r (p)	Resiliency Change from T0 to T2 r (p)
Depression and Anxiety Change from T0 to T2	-				
Depression and Anxiety Change from T0 to T1	**.718 (<.001)**	-			
Depression and Anxiety Change from T1 to T2	.230 (.240)	**-.512 (.005)**	-		
Resiliency Change from T1 to T2	.114 (.563)	.326 (.091)	-.314 (.103)	-	
Resiliency Change from T0 to T2	.022 (.910)	.198 (.312)	-.250 (.199)	**.447 (.017)**	-
Resiliency Change from T0 to T1	-.089 (.654)	-.059 (.623)	.067 (.736)	**-.540 (.005)**	**.512 (.005)**

Note. n = 28 for all correlations involving T2. n = 72 for all correlations involving only T0 or T1. r, Pearson's Correlation; T0, Initial survey responses; T1, First follow-up survey responses; T2, Second follow-up survey responses.

Resiliency as a Predictor of Substance Use

Mediation analyses were run and the Bonferroni procedure was implemented by setting the target *p*-value equal to α/C, where C is the number of tests performed. For this study, six mediation analyses were run, thereby the target *p*-value was .05/6, or .0083. Bootstrapped values (5000 iterations) of standard error and 95% confidence intervals were reported.

Mediation analysis of T1 resiliency scores on change in cannabis use from T0 to T1 through T1 depression and anxiety scores revealed only a significant a-path in which T1 resiliency scores account for 18.10% of the variance of T1 depression and anxiety scores, F (1, 69) = 15.25, R^2 = .181, p = .0002, all other pathways were non-significant, see Table 8 for more detailed information.

Table 8

The Mediating Effect of T1 Depression and Anxiety Scores on the Relationship Between T1 Resiliency Scores and T1 Change in Cannabis Use

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
T1 Resiliency on T1 Change in Cannabis Use without taking T1 Depression and Anxiety Scores into account (c)	-.062	-	.072	-.2149	.0709	.	-
T1 Resiliency on T1 Depression and Anxiety Scores (a)	-.426	-5.368	1.37	-8.110	-2.626	.0002	.18

T1 Depression and Anxiety Scores on T1 Change in Cannabis Use accounting for T1 Resiliency (b)	-.166	-.007	.006	-.0184	.307	.2139	-
T1 Resiliency on T1 Change in Cannabis Use through T1 Depression and Anxiety Scores (c')	.0382	-	.0533	-.0210	.1919	-	-

Note. $N = 72$. β = Standardized beta coefficient. B = Unstandardized beta coefficient. SE = Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T0 = Initial Survey Responses. T1 = First Follow-up Survey Responses. R^2 = Coefficient of Determination.

Mediation analysis of T1 resiliency scores on change in stimulant use from T0 to T1 through T1 depression and anxiety scores revealed only a significant a-path in which T1 resiliency scores account for 18.10% of the variance of T1 depression and anxiety scores, F (1, 69) = 15.25, R^2 = .181, p = .0002, all other pathways were non-significant, see Table 9 for more detailed information.

Table 9

The Mediating Effect of T1 Depression and Anxiety Scores on the Relationship Between T1 Resiliency and Change in Stimulant Use

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
T1 Resiliency on T1 Change in Stimulant Use without taking T1 Depression and Anxiety	-	.707	1.06	-1.365	2.778	.5038	-

Scores into account (c)							
T1 Resiliency on T1 Depression and Anxiety Scores (a)	-.426	-5.368	1.37	-8.110	-2.626	.0002	.18
T1 Depression and Anxiety Scores on T1 Change in Stimulant Use accounting for T1 Resiliency (b)	-	-.0814	.080	-.2379	.0750	.3077	-
T1 Resiliency on T1 Change in Stimulant Use through T1 Depression and Anxiety Scores (c')	.4371	-	53.513	-1.749	241.040	-	-

Note. N = 71. β = Standardized beta coefficient. B = Unstandardized beta coefficient. *SE* = Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T0 = Initial Survey Responses. T1 = First Follow-up Survey Responses. R^2 = Coefficient of Determination.

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Mediation analysis of T1 resiliency scores on change in benzodiazepine use between T0 and T1 through T1 depression and anxiety scores revealed a significant a-path in which T1 resiliency scores account for 18.10% of the variance of T1 depression and anxiety scores, F (1, 69) = 15.25, R^2 = .181, p = .0002. Additionally, the mediation analysis revealed a significant indirect effect of T1 resiliency scores on change in benzodiazepine use between T0 and T1 through T1 depression and anxiety scores (β = 2.276, *SE* = 90.734, bootstrapped 95% CI [1.2711, 308.3845]); although the confidence interval indicates significance, the difference between the lower limit and upper limit are far too wide to endorse a significant impact, see Table 10 for more detailed information. All other pathways were non-significant. A follow-up likelihood ratio test of an

interaction between T1 resiliency scores and T1 depression and anxiety scores on change in benzodiazepine use between T0 and T1 was non-significant, X^2 (1) = 5.344, p = .0208.

Table 10

The Mediating Effect of T1 Depression and Anxiety Scores on the Relationship Between T1 Resiliency Scores and Change in Benzodiazepine Use from T0 to T1

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
T1 Resiliency on T1 Change in Benzodiazepine Use without taking T1 Depression and Anxiety Scores into account (c)	-1.16	-	1.94	-4.9548	2.6345	.5490	-
T1 Resiliency on T1 Depression and Anxiety Scores (a)	-.426	-5.368	1.37	-8.110	-2.626	.0002	.18
T1 Depression and Anxiety Scores on T1 Change in Benzodiazepine Use accounting for T1 Resiliency (b)	-	-.424	.417	-1.2409	.3931	.3092	-
T1 Resiliency on T1 Change in Benzodiazepine Use through T1 Depression and Anxiety Scores (c')	2.2755	-	90.734	1.2711	308.45	-	-

Note. N = 71. β = Standardized beta coefficient. B = Unstandardized beta coefficient. *SE* = Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T0 = Initial Survey Responses. T1 = First Follow-up Survey Responses. R^2 = Coefficient of Determination.

Mediation analysis of T2 resiliency scores on change in stimulant use between

T1 and T2 through T2 depression and anxiety scores revealed only a significant a-path in which T2 resiliency scores account for 18.35% of the variance of T2 depression and anxiety scores, F (1, 26) = 5.84, R^2 = .1835, p = .0229, all other pathways were not significant, see Table 11 for more detailed information. After application of Bonferonni correction of multiple comparisons, the a-path was non-significant (p > .0083).

Table 11

The Mediating Effect of T2 Depression and Anxiety Scores on the Relationship Between T2 Resiliency Scores and Change in Stimulant Use between T1 and T2

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
T2 Resiliency on T2 Change in Stimulant Use without taking T2 Depression and Anxiety Scores into account (c)	-.158	-	1.491	-3.0799	2.7637	.9156	-
T2 Resiliency on T2 Depression and Anxiety Scores (a)	-	-5.567	2.303	-10.2998	-.8331	.0229	.18
T2 Depression and Anxiety Scores on T2 Change in Stimulant Use accounting for T2 Resiliency (b)	-	-.013	.117	-.2430	.2173	.9128	-
T2 Resiliency on T2 Change in Stimulant Use through T2 Depression and Anxiety Scores (c')	.0716	-	2.537	-.1565	.6582	-	-

Note. N = 28. β = Standardized beta coefficient. B = Unstandardized beta coefficient. *SE* = Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T1 = First Follow-up Survey Responses. T2 = Second Follow-up

Survey Responses. R^2 = Coefficient of Determination.

Mediation analysis of T2 resiliency scores on change in cannabis use between T1 and T2 through T2 depression and anxiety scores revealed only a significant a-path in which T2 resiliency scores account for 18.35% of the variance of T2 depression and anxiety scores, F (1, 26) = 5.84, R^2 = .1835, p = .0229, all other pathways were not significant, see Table 12 for more detailed information. After application of Bonferonni correction of multiple comparisons, the a-path was non-significant (p > .0083).

Table 12

The Mediating Effect of T2 Depression and Anxiety Scores on the Relationship T2 Resiliency Scores and Change in Cannabis Use from T1 to T2.

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
T2 Resiliency on T2 Change in Cannabis Use without taking T2 Depression and Anxiety Scores into account (c)	.1412	-	.1442	-.1557	.4381	.3368	-
T2 Resiliency on T2 Depression and Anxiety Scores (a)	-	-5.567	2.303	-10.2998	-.8331	.0229	.18
T2 Depression and Anxiety Scores on T2 Change in Cannabis Use accounting for T2 Resiliency (b)	.153	.008	.011	-.0150	.0307	.4882	-
T2 Resiliency on T2 Change in Cannabis Use through T1 Depression and Anxiety Scores (c')	-.0635	-	.1269	-.2851	.2388	-	-

Note. N = 28. β = Standardized beta coefficient. B = Unstandardized beta coefficient. *SE*

= Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T1 = First Follow-up Survey Responses. T2 = Second Follow-up Survey Responses. R^2 = Coefficient of Determination.

Mediation analysis of change in resiliency scores from T0 to T2 on change in cannabis use from T0 to T2 through change in depression and anxiety scores from T0 to T2 revealed no significant pathways, see Table 13 for more detailed information.

Table 13

The Mediating Effect of Change in Depression and Anxiety Scores from T0 to T2 on the Relationship Between Change in Resiliency Scores from T0 to T2 and Change in Cannabis Use from T0 to T2

Step	β	*B*	*SE*	95% LBCI	95% UBCI	*p*	R^2
Change in Resiliency on Change in Cannabis Use without taking Change in Depression and Anxiety Scores into account (c)	-.2301	-	.190	-.6222	.1619	.2380	-
Change in Resiliency on Change in Depression and Anxiety Scores (a)	-	.2885	2.533	-4.918	5.495	.9102	.0005
Change in Depression and Anxiety Scores on Change in Cannabis Use accounting for Change in Resiliency (b)	.287	.023	.0147	-.0077	.0530	.1369	-
Change Resiliency on Change in Cannabis Use	.006	-	.0603	-.0837	.1656	-	-

through Change in Depression and Anxiety Scores (c')									

Note. N = 28. β = Standardized beta coefficient. B = Unstandardized beta coefficient. *SE* = Standard Error. LBCI = Lower Bound Confidence Interval. UBCI = Upper Bound Confidence Interval. T0 = Initial Survey Responses. T2 = Second Follow-up Survey Responses. R^2 = Coefficient of Determination.

IV. DISCUSSION

The study aimed to provide more evidence into the relationship between resiliency, symptoms of anxiety and depression, perceived stress, PDM and cannabis use. Additionally, this study aimed to address how individuals obtain medications intended for PDM and obtain cannabis for use, focusing specifically on the extent to which individuals utilize various sources and how these choices might be influenced by sociodemographic factors, depression and anxiety symptoms, perceived stress, and resiliency over a three-month period; however, because of lack of responsiveness and attrition, inferential testing could not be performed and results could not be drawn. By collecting extensive sociodemographic characteristics, the study aimed to achieve a higher level of accuracy in representing the sample characteristics. Further, the study aimed to examine how those relationships, with variables that have been shown to change over short periods of time, like anxiety and depression, perceived stress, and resiliency, and how that change might impact PDM, cannabis use, and binge alcohol use, over a three-month period.

In contrast to previous research (e.g., Holt & McCarthy, 2020; Cabriales et al., 2013; Schepis & Hakes, 2011; 2013) inferring that depression and anxiety scores might influence PDM, the data from this sample suggests that there is not a relationship between depression or anxiety scores and PDM. This is highlighted in the fact that there was a significant change in reported depression and anxiety scores, however, there was not a significant change in PDM in this sample indicating that depression and anxiety scores might not influence PDM as heavily as predicted. However, this is probably because of the sample size and significant attrition rate from T0 to T2.

Similarly, opposed to Patrick et al. (2021), the data from this sample seems to

suggest that there is not a relationship between depression and anxiety scores and cannabis use. This, again, is highlighted in the fact that there was significant change reported in depression and anxiety scores, however, there was not a significant correlation between the change in depression and anxiety scores and a change in cannabis use in this sample. Because of the overabundance of research that suggests there is a relationship between psychopathology and PDM or cannabis use, like Holt and McCarthy (2020), Cabriales et al. (2013), Schepis and Hakes (2011; 2013), and Patrick et al. (2021), this may be a function of just the sample rather than a correlation that applies to the general population.

Consistent with previous PDM and cannabis research conducted on college students (e.g. Arria et al., 2013; Baghurst & Kelley, 2013; Cabriales et al., 2013; Chinnek et al., 2018), stimulants and cannabis were the most abundant used drugs among college students. Additionally, the data supports Schepis et al. (2020) in that young adults most primarily acquire drugs for free from family or friends. Even though most respondents did not report the degree to which they used a particular source for acquisition, even when they reported using multiple sources, there is still some evidence, especially from the few that responded, that degree of acquisition from particularly high-risk sources (e.g. buying drugs from a drug dealer) might be overlooked and invaluable information for future research.

Due to attrition rates within this sample, analyses using perceived stress had to be eliminated because of nonresponse bias evident when comparing the responders of T1 and T2 and the non-responders. Interestingly, the perceived stress scores of the responders were significantly higher than the non-responders, either way, this remains a

factor that may have a heavy influence on PDM and cannabis use in the non-responders. It is also worth noting that there is still a considerable gap in knowledge of how perceived stress levels might impact sources of PDM and cannabis use and, even more, the degree of acquisition from sources of PDM and cannabis use.

Because resiliency is widely understood as a significant coping factor and PDM and cannabis use have been posited to be external coping (i.e., the self-medicating hypothesis), this study sought to better understand how resiliency might interact with PDM and cannabis use (Smith et al., 2017; Masten, 2014). However, according to the data from this sample, resiliency does not seem to have an impact on PDM or cannabis use as changes in resiliency did not correlate with changes in PDM or cannabis use. However, an alternative reason is that there could be other methods of coping other than PDM and cannabis use that college students are utilizing for such small resiliency changes. So, it is possible that the magnitude of resiliency change might need to be more drastic than was seen in the present study in order to impact PDM and cannabis use in college students.

The main focus of this study was to investigate if changes in factors that have been well documented in influencing PDM and cannabis use might also impact sources of acquisition of PDM and cannabis use. However, because PDM and cannabis use did not change significantly over the study, changes in perceived stress scores, depression and anxiety scores, and resiliency scores showed that these factors are not the driving factor in determining PDM or cannabis use. Additionally, because respondents did not complete information regarding degree of acquisition when they obtained drugs from different sources, that portion of the analytic direction of this study remains incomplete.

In the future, I would recommend creating more user-friendly questions for reporting degree of acquisition from sources for participants to reduce attrition rates and reduce nonresponse bias. The current design asked participants to estimate percentage out of 100% they used specific sources, this style of question may have put too much burden on the respondents and led to burn-out or refusal to follow through on completion of follow-up surveys regardless of compensation.

Limitations

In interpreting our results, several limitations should be considered. First, high attrition rates within the sample may have impacted the generalizability of the findings, as some participants did not complete follow-up surveys, potentially introducing nonresponse bias into the results. This attrition could have been because of the nature of the questions in that nonrespondents did not feel confident that their confidential information would be protected. The attrition could have also been because of the specific sample population being undergraduate students at Texas State University. Additionally, another reason for the attrition could have been the timing of the data collection was from the end of October to the beginning of January, at this time, some students might not have checked the emails they provided for contact for follow-up surveys. Furthermore, due to this bias, analyses involving perceived stress had to be eliminated, which is unfortunate as stress might play a significant role in PDM and marijuana use according to some research (Bonn-Miller et al., 2008, 2011; Conway et al., 2006; Baum et al., 2021; Sattler 2019). In reference to demographic characteristics, there seems to be noticeable differences from T0 to T2; however, there were no inferential analyses performed on the impact of these changes due to non-response.

Another limitation lies in the lack of comprehensive information on the degree to which participants used specific sources for acquiring drugs. This information could prove invaluable for understanding the relationships between acquisition sources and various factors, like demographic factors or time-sensitive factors like perceived stress. Additionally, since there were not enough responses to show change in PDM and marijuana use, it is challenging to draw conclusions about the impact of factors such as perceived stress, depression and anxiety scores, and resiliency on these behaviors.

A further limitation of this study is that impulsivity of the sample was not considered in data analyses. Investigation into the influence of personality traits on PDM is a relatively recent development. Nevertheless, emerging research indicates that higher impulsivity is associated with prescription stimulant misuse (Chennick et al., 2018; Thiel et al., 2018). Moreover, N'Goran et al. (2014) propose that personality traits such as sensation-seeking, aggression and hostility, and anxiety and neuroticism positively correlate with increased PDM. Schmits & Glowacz (2018) also discovered that impulsivity predicted cannabis use. Given the strong evidence linking impulsivity with increased PDM and cannabis use, it is essential to examine whether impulsivity influences sources for PDM and cannabis use. Additionally, it is possible that there was a significant difference between responders and non-responders in impulsivity which might explain differences from expected outcomes.

An additional potential limitation of the analytic plan was that we used change scores which were calculated using the differences of scores on the different scales or in change in use of substances in the past 30 days of use compared to the previous 30 days of use (e.g. T1 vs T0, and T2 vs. T1). We also calculated a change score from the

difference of T2 vs. T0. This approach can lead to misleading causal-effect estimates as suggested by Tennant et al. (2021). In future research, we recommend controlling for T0 in testing for T1 differences and T2 differences so as to identify potential causal-effects from any changes in behaviors.

Due to the novelty of research on the influence of personality traits on PDM, a knowledge gap exists regarding how these traits affect sources for PDM. Furthermore, by identifying problematic personality traits related to PDM, Chinneck et al. (2018) suggest that targeted interventions could be implemented to prevent misuse. One such intervention proposed by Chinneck et al. (2018), albeit very costly, for individuals with heightened sensation-seeking or impulsivity levels, involves providing extracurricular activities on campus aligned with structured relapse prevention.

Further, the questionnaire design could benefit from improvements in the questions related to the degree of acquisition from different sources to reduce attrition rates and nonresponse bias. It is also important to note that the study focused on a college student population, which may limit the generalizability of the findings to other populations or age groups. Additionally, because this study focused on college students, this also might be why there was not a correlation between psychopathology and PDM or psychopathology and cannabis use. Lastly, as the study is observational in nature, establishing causal relationships between the studied variables is not possible; however, because this study was longitudinal, it is possible to apply temporal conclusions to the data.

Conclusion

In conclusion, the study aimed to investigate the relationships between sociodemographic factors, depression and anxiety symptoms, stress, impulsivity, resiliency, and substance misuse patterns, particularly PDM and cannabis use among college students. The results showed significant changes in resiliency scores, depression and anxiety scores, and perceived stress scores over the course of the study. Contrary to some previous research, I did not reveal any significant relationships between depression and anxiety scores and PDM or cannabis use in mediation analyses of resiliency on PDM and cannabis use through depression and anxiety scores. Additionally, because changes in resiliency did not correlate with changes PDM or cannabis use, or through changes in depression and anxiety, the results suggest that resiliency may not have a as great of an impact on PDM or cannabis use as previous research suggests. Due to small sample sizes and nonresponse, sources used for misuse and changes in sources used over time could not be properly analyzed. However, results of descriptive statistics of sources for PDM and cannabis use indicate that valuable information might be hidden within the degree of acquisition from sources, but also lack of response to degree of acquisition questions highlight the need for adjustment in questioning methodology, such as using manipulatable graphics (e.g., slider bars instead of free response percentage blanks). The findings of this study show the complexity of the relationships between these factors and the need for future research to aim at better understanding the relationships between these factors and PDM and cannabis use. By improving our understanding of the relationships between resiliency, depression and anxiety, perceived stress, PDM, cannabis use, and acquisition from sources, researchers and clinicians can develop more effective

interventions, such as education tools, and strategies targeting those relationships to address substance misuse in college students similar to the suggestions by Castellanos and Conrod (2009), Conrod (2016), and Hodder et al. (2017).

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